J. C. STEPHENS.

HEATING APPARATUS FOR USE IN OIL WELLS.

APPLICATION FILED JULY 20, 1920.

1,383,670. Patented July 5, 1921.

3 SHEETS—SHEET 1.

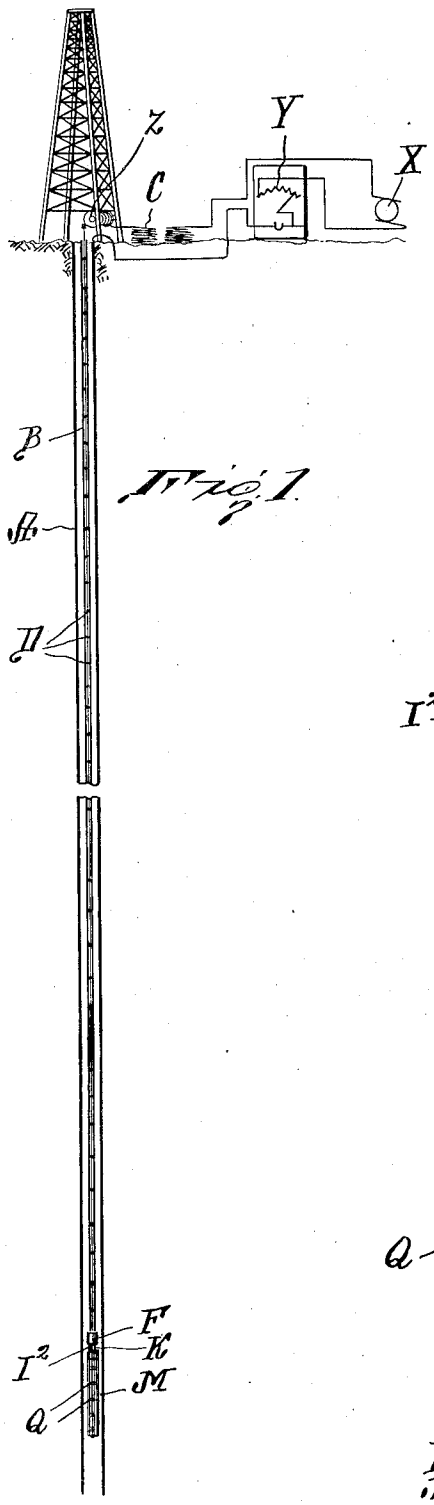

Fig. 1.

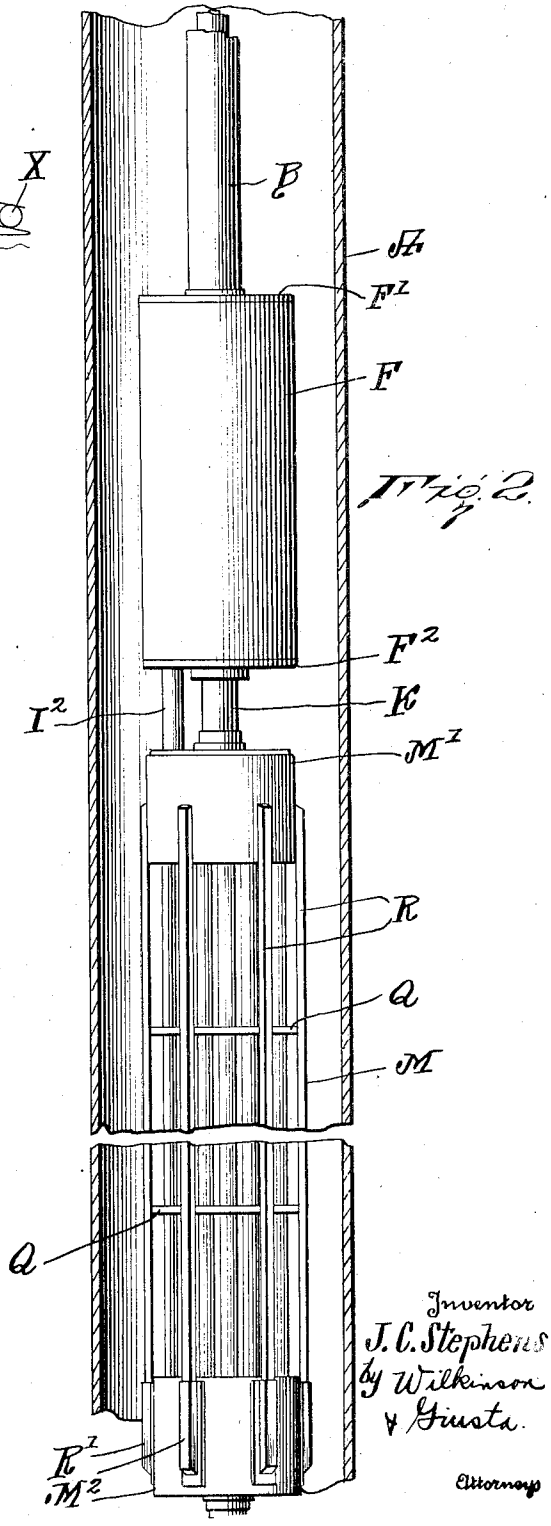

Fig. 2.

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Fig. 3.

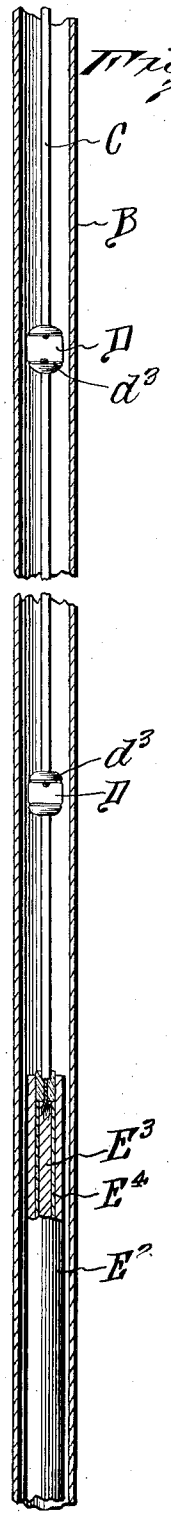


Fig. 4.

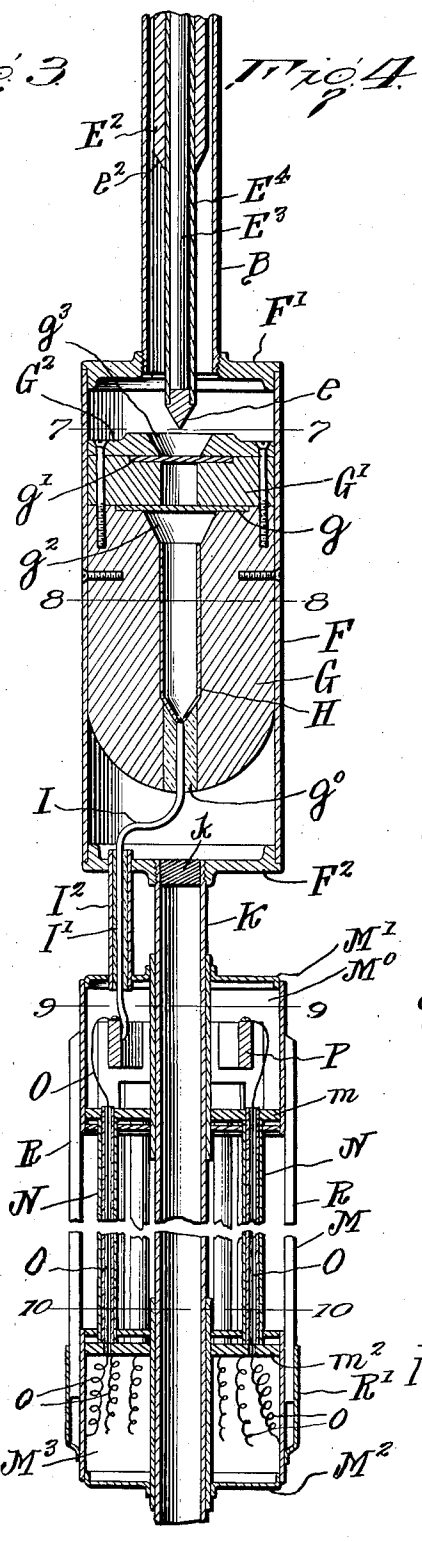
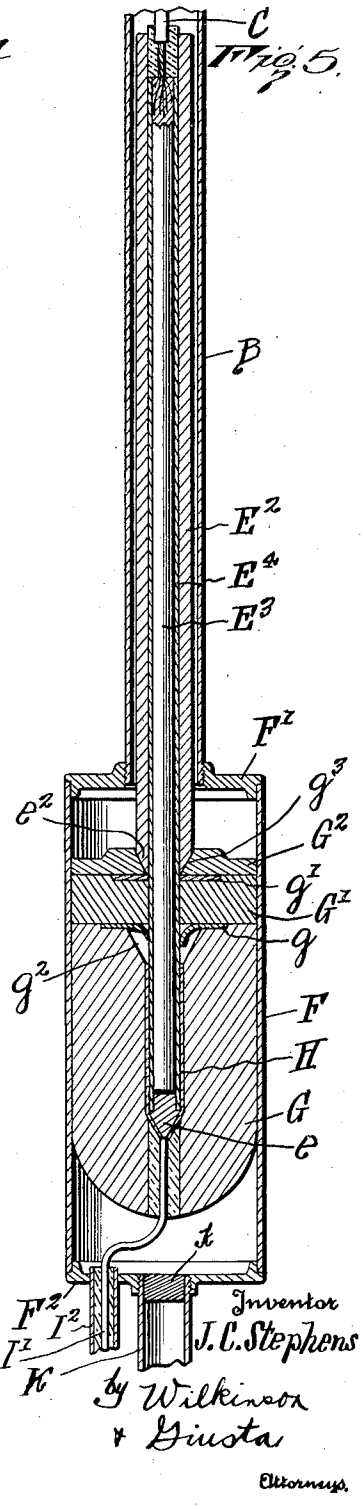


Fig. 5.



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3 SHEETS—SHEET 3.

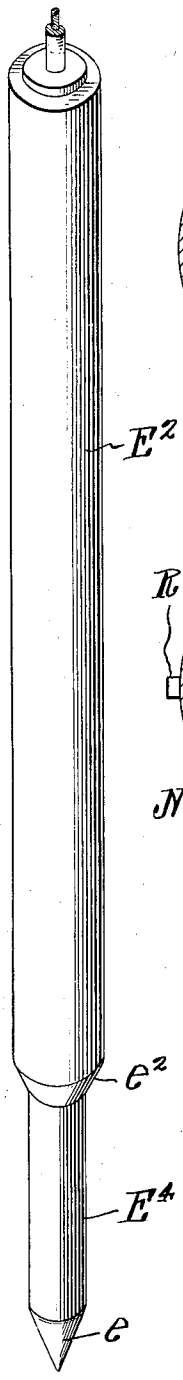

Fig. 6.

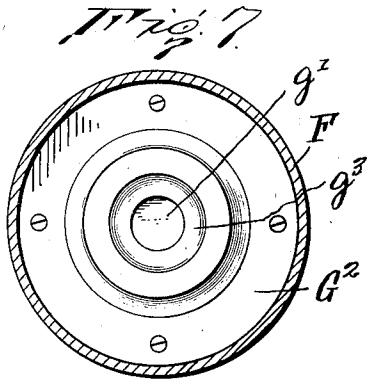

Fig. 7.

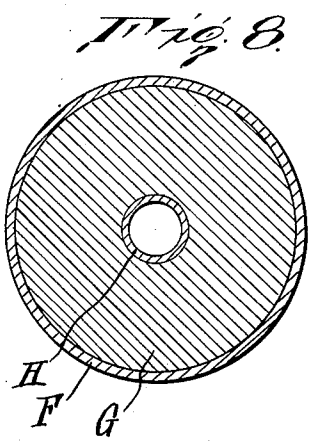

Fig. 8.

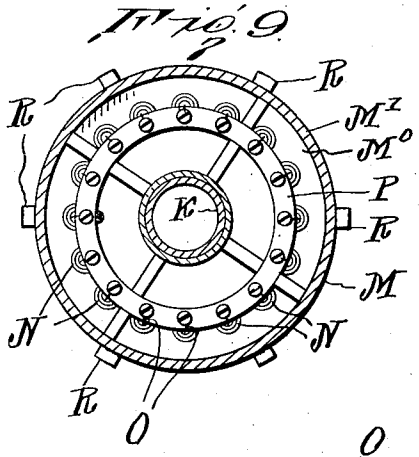

Fig. 9.

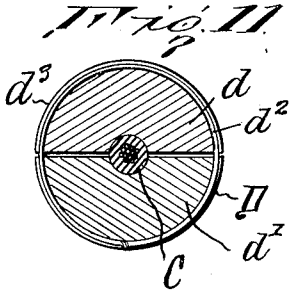

Fig. 11.

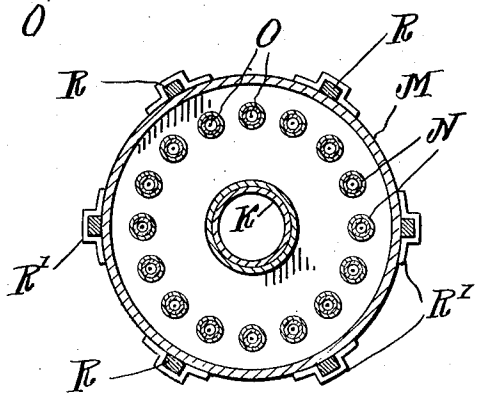

Fig. 10.

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UNITED STATES PATENT OFFICE.

JAMES CARLYLE STEPHENS, OF NORFOLK, VIRGINIA, ASSIGNOR TO HUFF PROCESS COMPANY, OF WILMINGTON, DELAWARE, A CORPORATION OF DELAWARE.

HEATING APPARATUS FOR USE IN OIL-WELLS.

1,383,670. Specification of Letters Patent. Patented July 5, 1921.

Application filed July 20, 1920. Serial No. 397,590.

To all whom it may concern:

Be it known that I, JAMES CARLYLE STEPHENS, a citizen of the United States, residing at Norfolk, in the county of Norfolk and State of Virginia, have invented certain new and useful Improvements in Heating Apparatus for Use in Oil-Wells; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

It is well known that all oil wells will ultimately cease to produce oil no matter how great may be the initial flow, or how much may be the quantity of oil in the ground contiguous to the well. The causes for the failure of the oil to flow are not only the actual removal of a large portion of the oil from the ground, but also the falling off of the gas pressure, or the choking up of the crevices through which the oil flows with paraffin or other matter which tends to impede and finally stop altogether the flow of the oil, or in any event cause it to flow so slowly that the well is no longer commercially productive.

It has long been known that the application of heat locally to the oil producing veins or sands would tend to melt the paraffin or to thin the oil and cause it to flow more freely, and also would generate gas which would tend to promote the resumption of the flow of the oil, and various methods have been devised for heating the well by steaming, hot air, hot water or by electric heaters.

Electric heaters probably afford a more convenient mode of applying locally the heat and continuing indefinitely its application, but the use of such heaters is attended with many serious objections which have hitherto rendered all electric apparatus devised for this purpose, as far as I am aware, inadequate and unsatisfactory.

Among the objections referred to is the fact that the well casings are of necessarily limited diameter, generally less than 7 inches, and the transverse diameter of the heater must therefore be less than the inner diameter of the well casing. Besides this, space must be left for the flow of the oil past the heater. The consequence is it has been found very difficult to generate enough heat to exercise any substantial effect upon the adjacent oil bearing strata.

Again, there have been great difficulties in securing the proper insulation, not only of the parts of the heaters themselves, but also for the conducting wires from which the heater is suspended; these oil wells being frequently 3000 feet more or less in depth.

It will be noted that the heater must be capable of efficient use in water, crude oil, or salt water such as is found in wells. Great difficulties are also experienced in taking care of sudden expansion and contraction of the parts, due to certain changes in the temperature.

In order to remedy as far as practicable certain of the objections as have just been noted, I have devised the present invention, which will be more clearly understood after reference to the accompanying drawings, in which like parts are indicated by similar reference symbols throughout the several views, and in which:—

Figure 1 is a diagrammatic view showing a section through the well casing, with the inner tube in elevation, and the junction box and heater suspended from the inner tube.

Fig. 2 is a view on a larger scale of the lower portion of the apparatus shown in Fig. 1, the well casing being shown in section, and the heater and junction box being shown in elevation, parts being broken away.

Fig. 3 shows a section through a portion of the inner tube, with the conducting cable projecting thereinto, and the upper end of the circuit closer attached to the cable, parts being broken away.

Fig. 4 shows on a larger scale a vertical section through the junction box and the heater, and shows the circuit closer in the raised position with the circuit open, parts being broken away.

Fig. 5 is a similar view to the upper portion of Fig. 4, but shows the circuit closer in the position for closing the circuit.

Fig. 6 is a detail showing the circuit

closer detached from the apparatus, the parts being shown on a still larger scale than in the preceding figures.

Fig. 7 shows a section along the line 7—7 of Fig. 4, and looking down.

Fig. 8 shows a section along the line 8—8 of Fig. 4, and looking down.

Fig. 9 shows a section along the line 9—9 of Fig. 4, and looking down.

Fig. 10 shows a section along the line 10—10 of Fig. 4, and looking down; and

Fig. 11 shows a cross section on a larger scale of one of the insulating fenders for the cable.

A represents the well casing which is of the usual construction, and the internal diameter of which will ordinarily be about six inches.

B shows the inner tube which is also constructed in the usual way.

C represents the conducting cable which may be of any suitable construction, but should be well insulated and capable of carrying sufficient current for the purposes required.

In order to protect this cable from injury as it is lowered down, or hauled up out of the well, I preferably attach thereto at intervals a number of insulating blocks D, preferably composed of two members d and d', see Fig. 11, cut away at the center to receive the cable, and held together in any suitable way, as by means of pieces of wire d^2 engaging in the grooves d^3, see Figs. 3 and 11. These blocks are preferably rounded at the ends, as shown in Fig. 3, so that they may be drawn freely up and down in the inner tube. It will be seen that these blocks serve as fenders, and prevent the exterior of the cable from coming in contact with the inner wall of the inner tube, or with any foreign matter that may have accumulated in said tube.

Secured at the lower end of the cable C is the circuit closer E, which consists of a metal tube E^4 in electrical contact with the end of the cable, which tube is preferably inclosed in an insulating casing E^2, and on the inside of the tube I provide a rod E^3 having a rounded end e, adapted to break the seals in the contact box f, as will be hereinafter described.

This contact box F is preferably in the form of a hollow cylinder, having the screw caps F′ and F^2. Mounted inside of the box I provide three insulating blocks G, G′ and G^2, each centrally perforated, as shown in Fig. 4.

Mounted between the blocks G and G′ is a perforable seal g, which may be made of leather or other suitable material, while between the blocks G′ and G^2 is a second perforable seal g' which may be made of lead or other suitable material, and the openings of the blocks G and G^2 are preferably provided with tapered throats g^2 and g^3.

The lower insulating block G is provided with a conducting tube H, connected with a leading-in conductor I, which leading-in conductor passes through the insulating plug g^0, closing the lower end of the passage through the block G. This conductor I passes through an insulating tube I′, preferably of glass, and the metal tube I^2, which connects the junction box F with the head M′ of the heater M. The junction box is also connected to the heater by the tube K, whose upper end is closed by a plug k.

The upper head M′ of the heater is fast to this tube K, and the lower head M^2 slides freely on the said tube, so as to allow for expansion and contraction of the tubes of the heater. The upper head of the heater is closed at its bottom by a diaphragm m, forming a closed chamber M^0 in which the conducting ring P is mounted, to which ring the various wires O of the heating coils are connected.

The bottom head of the heater is provided with a diaphragm m^2, forming a closed chamber M^3 the walls of which chamber are in electrical contact with the coiled lower end o of the heating wires O. These heating wires pass through insulating material contained in the tubes N.

In order to protect the parts of the heater from injury, I provide a series of longitudinal rods R, connected at their upper ends to the head M′ of the heater, and sliding at their lower ends in the sockets R′ carried by the lower head M^2 of the heater; this sliding movement permitting the contraction and expansion of the parts of the heater.

The rods R and the tubes N are braced by the rings Q, which form with the said rods a protective cage for the heater.

It will be noted that the junction box F and heater M are suspended from the lower end of the inner tube, B, while the conducting cable C carries only the fender blocks D and the circuit closer E.

Current is supplied from any suitable source of electricity, as is shown diagrammatically in Fig. 1, by the generator X and the controller Y. The cable C is shown as running over a pulley Z. A suitable cable drum may be used if desired.

The operation of the device is as follows:

The contact box F with the heater M attached as shown in Fig. 4 is connected to the lower end of the inner tube B, and this tube is then lowered into the well, the various sections of the inner tube being added in the usual well known way. When the inner tube has reached the desired depth, the circuit closer E attached to the end of the cable C is lowered into the inner tube until the point e of the circuit closer E is

at or near the position shown in Fig. 4, at which time the seals g and g' will remain unbroken and the circuit will be open.

Now, if the circuit closer be allowed to drop suddenly, the point e will perforate the seals g and g' and the point e and the tube E' will make contact with the tube H, and will close the circuit through the conductor I and the heater M.

In the operation of the device water or other liquid will be kept clear of the various contact points and efficient insulation will be secured.

Current may be kept on the heater indefinitely, or until the desired results are secured in the well. After the application of heat has been sufficient to adequately clean the well, the cable C and circuit closer E are withdrawn, the inner tube carrying the junction box or casing is pulled up out of the well and if the well does not flow under its own pressure the usual pumping appliance may be inserted and operated in the usual way.

It will be obvious that various modifications might be made in the herein described apparatus, and in the construction, combination and arrangement of parts which could be used without departing from the spirit of my invention; and I do not mean to limit the invention to such details except as particularly pointed out in the claims.

Having thus described my invention what I claim and desire to secure by Letters Patent of the United States is:—

1. Apparatus for use in heating oil wells, comprising an inner tube projecting down into the casing, a closed contact box carried by said tube and provided with an insulated contact therein, an electric heater suspended from said contact box, electric conductors leading from said contact box to said heater, an electric cable, and a circuit closer suspended from said cable adapted to be lowered through said tube and to close the circuit through said contact box, substantially as described.

2. Apparatus for use in heating oil wells, comprising an inner tube projecting down into the casing, a closed contact box carried by said tube and provided with an insulated contact therein, and with a perforable diaphragm screening said contact box, an electric heater suspended from said contact box, electric conductors leading from said contact box to said heater, an electric cable, and a circuit closer having a pointed end suspended from said cable and adapted to perforate said diaphragm and close the circuit through said contact, substantially as described.

3. Apparatus for use in heating oil wells comprising an inner tube projecting down into the casing, a closed contact box carried by said tube, the said contact box being provided with an insulated contact piece, and a series of centrally perforated disks of insulating material located above said contact piece, with perforable diaphragms held between said disks, an electric heater suspended from said contact box, an electric conductor leading from said contact box to said heater, an electric cable, and a circuit closer having a pointed end suspended from said cable and adapted to perforate said diaphragms and close the circuit through said contact piece, substantially as described.

4. Apparatus for use in heating oil wells comprising an inner tube projecting down into the casing, a closed contact box carried by said tube, the said contact box being provided with an insulated contact piece, and a series of centrally perforated disks of insulating material located above said contact piece, with perforable diaphragms held between said disks, an electric heater suspended from said contact box, an electric conductor leading from said contact box to said heater, an electric cable, and a circuit closer comprising a rod, having a pointed end, suspended from the fore end of said cable and adapted to perforate said diaphragms and to close the circuit through said contact piece, substantially as described.

5. Apparatus for use in heating oil wells, comprising an inner tube projecting down into the casing, a closed contact box carried by said tube and provided with an insulated contact therein, an electric heater suspended from said contact box, electric conductors leading from said contact box to said heater, an electric cable, a series of separable blocks of insulating material mounted exterior to said cable and forming fenders therefor, and a circuit closer suspended from said cable adapted to be lowered through said tube and to close the circuit through said contact box, substantially as described.

6. Apparatus for use in heating oil wells, comprising an inner tube projecting down into the casing, a closed contact box carried by said tube and provided with an insulated contact therein, and with a perforable diaphragm screening said contact box, an electric heater suspended from said contact box, electric conductors leading from said contact box to said heater, an electric cable, a series of separable blocks of insulating material mounted exterior to said cable and forming fenders therefor, and a circuit closer having a pointed end suspended from said cable and adapted to perforate said diaphragm and close the circuit through said contact, substantially as described.

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